I-81 Corridor Improvement Study: Existing and Future Conditions Data Analysis

October 2004

This information is being developed as part of the National Environmental Policy Act (NEPA) process and will be part of the Purpose and Need section of the Environmental Impact Statement. All data presented herein are preliminary and subject to change prior to the public availability of the approved Tier 1 Draft Environmental Impact Statement. VDOT values public input, and comments or questions received about these data will be considered as part of the public availability and comment process for the Tier 1 DEIS.

Existing and Future Conditions Data Analysis

The information presented in this report has been collected, obtained from others, or is a direct result of analyses conducted in conjunction with the I-81 Corridor Improvement Study. This information is being developed as part of the National Environmental Policy Act process and will become part of the Purpose and Need chapter of the Environmental Impact Statement. This information is preliminary and subject to change prior to the public availability of the Tier 1 Draft Environmental Impact Statement. A draft Purpose and Need chapter will be available for public information prior to release of the Draft Environmental Impact Statement in early 2005. A more detailed technical report containing analyses and methods on existing and future conditions will be made available with the Draft Environmental Impact Statement, which will be available for public comment in early 2005.

Existing Conditions

Existing conditions were identified using existing data as well as new data gathered as part of this study. Existing data were collected and analyzed to define the existing conditions and establish a benchmark of comparison for 2035 No-Build conditions. Traffic operating conditions, crashes, and geometric deficiencies have been identified, and analyses are under way to verify the data, develop improvement concepts, and analyze the effectiveness of those concepts. The traffic information was collected in the field by the study team in the year 2004. The crash data analyzed are from the three-year period of 2000 to 2002, and the existing geometric deficiencies were identified from field visits, aerial photography, and review of the most recent construction plans for the entire corridor.

Traffic operating conditions along I-81 were evaluated with respect to the existing highway infrastructure to assess the overall quality of traffic flow using the procedures documented in the 2000 Highway Capacity Manual (HCM)[1]. A level of service (LOS) analysis was conducted for the mainline of I-81 as well as for all ramp merges, diverges, and weave areas. LOS is a qualitative measurement of the operating conditions that takes into account a number of variables such as speed, vehicle maneuverability, and traffic interruptions. A letter grade ranging from LOS A (representing the free flow of traffic) to LOS F (representing a forced or breakdown in traffic flow) is assigned to each location. Figure 1 contains photographs that illustrate various levels of service. The American Association of State Highway and Transportation Officials (AASHTO) document A Policy on Geometric Design of Highways and Streets (Green Book) is referenced in the Code of Federal Regulations and is used to provide the LOS standard for highways on the National Highway System, which includes I-81. In rural areas of I-81, the standard for the mainline is LOS B, and the standard for the ramps and weave areas (the crossing of two or more traffic streams traveling in the same direction along a significant length of highway) in Virginia is LOS C. In urban areas of I-81, the standard for the mainline as well as the ramps and weave

1 2000 Highway Capacity Manual; Transportation Research Board, National Research Council; Washington D.C. 2000

areas is LOS C. A map showing existing levels of service along the corridor is attached (Figure 2).

The following tables include data that illustrate the existing transportation conditions. These data will be used in subsequent analysis of existing conditions. Because of the noticeable change in the average annual growth rates that has occurred during the past few years, the rates for the overall 25 year period and the rates for the last seven years are shown separately. The rates were also shown separately because 1997 is the year the automated count stations along I-81 became operational; therefore, data from 1997- 2003 is based on more accurate and continuous counting methods than the rates in years prior to 1997. Trucks have not experienced the same change and therefore those growth rates are not shown with separate and distinct time frames.

Existing Traffic and Historical Traffic Volume Growth along I-81: 1978-2003

					1978 – 2003		1997 – 2003	
Location (from South to North) [A]	1978 AADT Volume [B]	1997 AADT Volume [C]	2003 AADT Volume [D]	2003 Truck Percentage [E]	Average Annual Growth Rate [F]	Aggregate Growth [G]	Average Annual Growth Rate [H]	Aggregate Growth [I]
Route 140 to South Corporate Limit of Abingdon	18,100	37,000	41,000	23%	3.3%	127%	2.1%	11%
Route 11 to North Corporate Limit of Wytheville (I-77 overlap)	21,400	46,800	51,900	26%	3.6%	143%	1.7%	11%
Route 177 to Route 8 (near Radford)	15,400	32,000	41,000	27%	4.0%	166%	4.2%	28%
Route 581 to Route 115 (Roanoke)	24,700	52,000	57,100	21%	3.4%	131%	1.6%	10%
Route 11 to Route 11-614 (Buchanan	13,800	30,000	34,300	35%	3.7%	149%	2.3%	14%
Route 606 to Augusta County Line (I-64 overlap)	15,300	33,000	41,700	32%	4.1%	173%	4.0%	26%
Route 11 to Route 659 (Harrisonburg)	16,700	39,000	48,000	27%	4.3%	187%	3.5%	23%
Route 50 to Route 7	18,900	48,000	56,200	21%	4.5%	197%	2.7%	17%
Overall Corridor Average	**18,000**	**39,725**	**46,400**	**26%**	**3.9%**	**158%**	**2.7%**	**17%**

This table shows historical as well as current traffic volumes and growth along I-81. The columns labled A-H represent:

A – The section of I-81 that these volumes represent. Each section contains a permanent count station continuously monitored by VDOT.
B – The Annual Average Daily Traffic (AADT) on weekdays for the year 1978.
C – The AADT on weekdays for the year 1997.
D – The AADT on weekdays for the year 2003.
E - Percent of 2003 AADT that are trucks.
F – Average rate of traffic growth (compounded) experienced per year between 1978 and 2003.
G – The total percent increase of 2003 average daily traffic as compared to 1978 average daily traffic.

H – Average rate of traffic growth (compounded) experienced per year between 1997 and 2003.
I – The total percent increase of 2003 average daily traffic as compared to 1997 average daily traffic.

Freight statistics, surveys and field observations are being analyzed in order to determine the local, regional and through truck percentages.

The I-81 (weighted average) crash rates are less than the 2002 statewide weighted average crash rate for interstate highways (160 for I-81 versus 277 crashes per 100 million vehicle miles of travel for the average interstate in Virginia). These are preliminary results, and crash data continues to be analyzed as we move toward the completion of the DEIS.

Specific segments that were identified with crash rates more than 25 percent higher than the statewide weighted average include:

- Mileposts 7-8; 16-17; 23-24; 45-46; 49-50; 80-81; 105-106; 109-110; 156-157; 181-182; 189-90; 195-196; 213-214; 223-224; 252-253; 292-293; and 296-298 in the northbound direction.
- Mileposts 319-318; 315-314; 300-299; 285-284; 275-274; 249-246; 206-205; 203-202; 197-96; 171-169; 151-150; 122-121; 95-94; 68-67; 44-43; 35-34; and 8-7 in the southbound direction.

Specific segments that were identified with crash rates more than double the statewide weighted average include:

- Mileposts 73-74 northbound (Wytheville)
- Mileposts 94-95 northbound (Pulaski)
- Mileposts 162-163 northbound (south of Buchanan)
- Mileposts 168-169 northbound (north of Buchanan)
- Mileposts 180-181 northbound (north of Natural Bridge)
- Mileposts 292-293 northbound (south of Strasburg)
- Mileposts 314-315 northbound (Winchester)
- Mileposts 49-48 southbound (north of Marion)

The review of I-81 crash history over the three-year period from 2000 to 2002 also did not show a disproportionately high involvement of trucks in crashes. Trucks constitute approximately 29 percent of all vehicle miles traveled and were involved in approximately 29 percent of all reported crashes and 29.6 percent of all fatal crashes.

Existing I-81 Interchange Geometric Deficiencies

Deficiency [A]	Number of Locations [B]	Interchange(s) [C]
Insufficient ramp geometry and/or length	10	35, 39, 47, 50, 67,70,80,126, 251, 291
Insufficient ramp termini spacing on side road	23	24, 26, 29, 32, 35, 39, 45, 47, 60, 80, 84, 86, 89, 92, 109, 205, 243, 245, 273, 302, 307, 310, 313
Insufficient weaving distance between northbound ramps	2	14, 94
Insufficient weaving distance between southbound ramps	4	247, 220, 221, 222
Insufficient stopping sight distance on ramps	3	67, 296, 302
Steep ramp grade (greater than 8% grade)	1	45
Low ramp design speed (less than 25 mph)	3	41, 72, 81
Insufficient tapers, acceleration and/or deceleration lane lengths	12	132, 137, 140, 141, 143, 146, 156, 162, 167, 168, 180, 323
Substantial ramp delay and backup	4	150, 205, 247, 313
Left-hand exit ramp safety issues	4	143, 180, 191, 300
Insufficient ramp geometry at rest area	2	Northbound Milepost 129.3, Southbound Milepost 158

This table shows areas along I-81 that have design problems such as inadequate shoulder width, inadequate vertical clearance, inadequate sight distance, the absence of truck climbing lanes, and/or inadequate acceleration and deceleration lanes. These design problems are referred to as geometric deficiencies. The columns labeled A-C represent:

A – The design problem identified based on AASHTO criteria and preliminary observations/analyses.
B – The number of locations in the study area that displayed this particular deficiency.
C – The interchange(s) or mileposts where this particular deficiency was identified.

Future Conditions

The 2035 No-Build condition assumes that only those roadway and rail projects identified for construction in the constrained Long Range Transportation Plans throughout the corridor and the Six-Year Improvement Program will be built. Traffic projections for the future year were developed using information from previous studies, new research, and surveys. Most of the information from previous studies does not project as far into the future as this Tier 1 study. Data from these studies were analyzed to extend the projections to the same year as the 2035 traffic projections for this study.

Analyses of the 2035 traffic operating conditions are being conducted, and preliminary results are presented in Figure 3 as levels of service.

Safety is a problem in some locations today and is expected to worsen by 2035 as volumes increase, the operating conditions deteriorate, and the existing geometric deficiencies remain.

The following tables include data used in developing projections of the 2035 No-Build conditions.

Projected Total Traffic Volume Growth along I-81: 2004-2035

Location (from south to north)[A]	Milepost Range [B]	2004 AADT Volume [C]	2035 AADT Volume [D]	2035 AADT Truck Percentage [E]	Average Annual Growth Rate [F]	Aggregate Growth [G]
Route 140 to South Corporate Limit of Abingdon	15 to 17	42,100	74,400	30%	1.9%	77%
Route 11 to North Corporate Limit of Wytheville (I-77 overlap)	73 to 76	54,100	100,000	34%	2.0%	85%
Route 177 to Route 8 (near Radford)	109 to 114	42,900	77,800	35%	1.9%	81%
Route 581 to Route 115 (Roanoke)	144 to 147	58,800	114,100	26%	2.2%	94%
Route 11 to Route 11-614 (Buchanan)	168 to 174	35,600	63,000	45%	1.9%	80%
Route 606 to Augusta County Line (I-64 overlap)	205 to 213	42,900	77,700	42%	1.9%	81%
Route 11 to Route 659 (Harrisonburg)	244 to 246	49,400	91,000	33%	2.0%	84%
Route 50 to Route 7	314 to 316	58,500	109,000	26%	2.0%	86%
Overall Corridor Average		**48,000**	**88,400**	**33%**	**2.0%**	**84%**

This table shows growth rates and projections for the I-81 corridor. The columns labeled A-F represent:

A – The section of I-81 that these volumes represent. Each section contains a permanent count station continuously monitored by VDOT.
B – The location of each permanent count station, represented by milepost range.
C – The projected AADT on weekdays for 2004 based on counts collected for this study.
D – The AADT on weekdays for 2035 as projected for this study.
E - Percent of 2035 AADT that are trucks.
F – The average rate of traffic growth per year (compounded) projected to be experienced between 2004 and 2035.
G – The total projected percent increase of 2035 average daily traffic on weekdays as compared to 2004 average daily traffic.

Projected Truck Traffic Volume Growth along I-81: 2003-2035

I-81 Segment [A]	2003 AADT Trucks[B]	2035 AADT Trucks[C]	Average Annual Growth Rate [D]	Aggregate Growth [E]
Route 140 to South Corporate Limit of Abingdon	9,180	22,310	2.8%	143%
Route 11 to North Corporate Limit of Wytheville(I-77 overlap)	13,450	33,970	2.9%	153%
Route 177 to Route 8 (near Radford)	11,240	27,120	2.8%	141%
Route 581 to Route 115 (Roanoke)	11,990	30,210	2.9%	152%
Route 11 to Route 11-614 (Buchanan)	11,970	28,130	2.7%	135%
Route 606 to Augusta County Line(I-64 overlap)	13,480	32,750	2.8%	143%
Route 11 to Route 659 (Harrisonburg)	12,870	30,330	2.7%	135%
Route 50 to Route 7	11,850	28,220	2.7%	138%

This table shows growth rates and projections for trucks in the I-81 corridor. The columns labeled A-E represent:

A – The section of I-81 that these volumes represent. Each section contains a permanent count station continuously monitored by VDOT.
B – The projected AADT for trucks in 2003 based on counts collected for this study.
C – The AADT for trucks in 2035 as projected for this study.
D – The average rate of traffic growth per year (compounded) for trucks projected to be experienced between 2003 and 2035.
E – The total percent increase of 2035 average daily truck traffic as compared to 2003 average daily truck traffic.

Summary

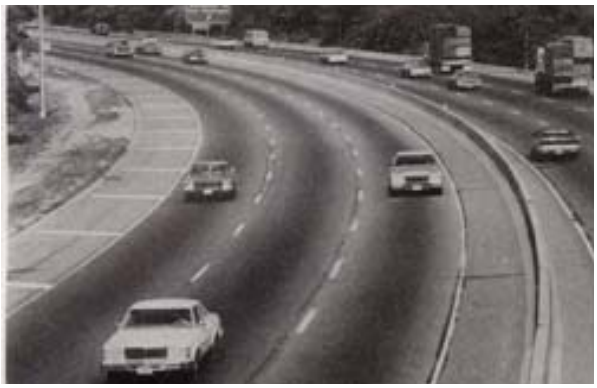
Existing Conditions on the I-81 Corridor

1. 24 northbound miles operate below LOS standards (Figure 2).
2. 32 southbound miles operate below LOS standards (Figure 2).
3. 8 miles (7 northbound and 1 southbound) experience more than twice the statewide average crash rate.
4. 24 northbound miles experience crash rates more than 25 percent higher than the statewide average crash rate.
5. 20 southbound miles experience crash rates more than 25 percent higher than the statewide average crash rate.
6. 21 percent of all crashes and 33 percent of all fatal crashes occur within segments totaling 44 miles in the corridor (the areas listed in the previous two bullets which constitute 8 percent of the 650 total corridor miles – 325 northbound and 325 southbound).
7. Trucks constitute 29 percent of the total vehicle miles traveled in the corridor between 2000 and 2002, and trucks were involved in 29 and 29.6 percent of all crashes and fatal crashes, respectively.
8. More than two-thirds of I-81 in Virginia has inadequate inside shoulder width based on the volume of trucks using the roadway.
9. More than 100 locations of insufficient sight distances have been identified because of the vertical alignment of the highway.
10. Seven extended highway segments with no relief from a minimum 2% grade warrant truck climbing lanes, including a 12-mile segment northbound from approximately Milepost 190 to 202.
11. Approximately 53 bridges of the 126 bridge underpass locations have substandard vertical clearance based on AASHTO design criteria.
12. 2004 average truck percentage is 26% of the traffic at the eight permanent count stations along I-81.

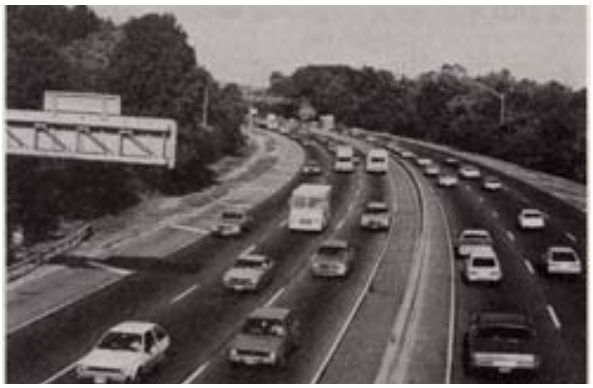
Projected 2035 Conditions

1. 295 northbound miles (91 percent) operate below LOS standards (Figure 3).
2. 299 southbound miles (92 percent) operate below LOS standards (Figure 3).
3. Problems associated with items 3-11 above also will exist in the future condition.
4. 2035 average truck percentage is 33% of the projected traffic at the eight permanent count stations along I-81.

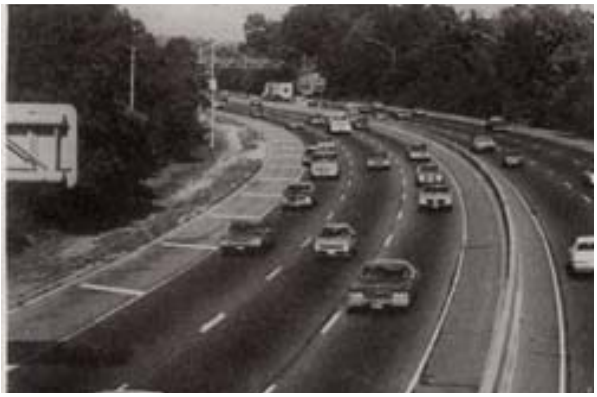
FIGURE 1. LEVEL OF SERVICE (LOS) DEFINITIONS



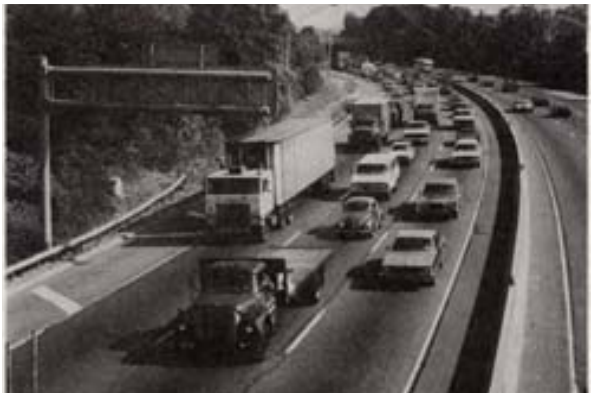
Level of Service A: Free-flow traffic with individual users virtually unaffected by the presence of others in the traffic stream.



Level of Service D: High-density flow in which speed and freedom to maneuver are severely restricted and comfort and convenience have declined even though flow remains stable.



Level of Service B: Stable traffic flow with a high degree of freedom to select speed and operating conditions but with some influence from other users.



Level of Service E: Unstable flow at or near capacity levels with poor levels of comfort and convenience.

Level of Service C: Restricted flow that remains stable but with significant interactions with others in the traffic stream. The general level of comfort and convenience declines noticeably at this level.

Level of Service F: Forced traffic flow in which the amount of traffic approaching a point exceeds the amount that can be served. LOS F is characterized by stop-and-go waves, poor travel times, low comfort and convenience, and increased accident exposure.

North

0 10 20 Miles

Winchester
Harrisonburg
Staunton
Lexington
Roanoke
Christiansburg
Marion
Wytheville

Frederick
Clarke
Loudoun
Arlington
Shenandoah
Warren
Fairfax
Fauquier
Rappahannock
Prince William
Rockingham
Page
Culpeper
Stafford
Madison
Highland
Greene
Fredericksburg
King George
Orange
Spotsylvania
Augusta
Waynesboro
Charlottesville
Albemarle
Caroline
Louisa
Bath
Clifton Forge
Rockbridge
Fluvanna
Nelson
Hanover
Alleghany
Buena Vista
Goochland
King William
Amherst
Botetourt
Buckingham
Powhatan
Cumberland
Richmond
Henrico
Craig
Chesterfield
Appomattox
Amelia
Giles
Petersburg
Buchanan
Campbell
Prince Edward
Prince George
Bedford
Tazewell
Nottoway
Dickenson
Bland
Pulaski
Montgomery
Dinwiddie
Wise
Franklin
Russell
Wythe
Floyd
Charlotte
Lunenburg
Sussex
Smyth
Pittsylvania
Halifax
Washington
Carroll
Brunswick
Scott
Lee
Patrick
Martinsville
South Boston
Mecklenburg
Southampton
Grayson
Henry
Greensville

West Virginia
Kentucky
Virginia
Tennessee
North Carolina

66
81
64
77
95
85

Level of Service

- A/B
- C Rural
- C Urban
- D
- E/F

North

Existing Level of Service Summary

I-81 Northbound and Southbound
2004 Traffic Volumes

Figure **2.3**

I-81 CORRIDOR IMPROVEMENT STUDY

North

0 10 20 Miles

Winchester
Harrisonburg
Staunton
Lexington
Roanoke
Christiansburg
Marion
Wytheville

Frederick
Clarke
Loudoun
Arlington
Shenandoah
Warren
Fairfax
Fauquier
Rappahannock
Prince William
Rockingham
Page
Culpeper
Stafford
Madison
Highland
Fredericksburg
King George
Greene
Orange
Spotsylvania
Augusta
Waynesboro
Charlottesville
Caroline
Bath
Louisa
Albemarle
Clifton Forge
Fluvanna
Rockbridge
Nelson
Hanover
Alleghany
Buena Vista
Goochland
King William
Amherst
Botetourt
Buckingham
Powhatan
Cumberland
Richmond
Craig
Henrico
Chesterfield
Appomattox
Amelia
Giles
Buchanan
Campbell
Prince Edward
Petersburg
Prince George
Bedford
Tazewell
Bland
Pulaski
Montgomery
Nottoway
Dinwiddie
Wise
Dickenson
Franklin
Russell
Floyd
Charlotte
Lunenburg
Sussex
Wythe
Pittsylvania
Halifax
Brunswick
Smyth
Carroll
Mecklenburg
Scott
Washington
Lee
Patrick
Martinsville
South Boston
Grayson
Henry
Greensville

West Virginia
Kentucky
Virginia
Tennessee
North Carolina

Level of Service

- A/B
- C Rural
- C Urban
- D
- E/F

North

Future Level of Service Summary

I-81 Northbound and Southbound
2035 Traffic Volumes

Figure **2.4**

I-81 CORRIDOR IMPROVEMENT STUDY